Chemical Characteristics of Selected Rivers in Guysborough County, Nova Scotia, 1984

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ABSTRACT

MacPhail, D.K., D. Ashfield and G.J. Farmer. 1987. Chemical characteristics of selected rivers in Guysborough County, Nova Scotia, 1984. Can. Data Rep. Fish. Aquat. Sci. No. 645. v + 13 p.

Chemical characteristics of eight rivers located in Guysborough County, Nova Scotia, were measured on two occasions during 1984. Hatchery-reared juvenile salmon have not been released in these rivers during recent years, but some are considered as possible sites for salmon enhancement programs. The chemical characteristics presented in this report can be examined to help determine the sensitivity of the rivers to acid precipitation, to facilitate the planning of salmon enhancement programs and to enable the selection of suitable release sites for hatchery-reared juveniles.

Key words: Atlantic salmon rivers, Guysborough County, Nova Scotia, water chemistry, salmon enhancement.

RÉSUMÉ

MacPhail, D.K., D. Ashfield and G.J. Farmer. 1987. Chemical characteristics of selected rivers in Guysborough County, Nova Scotia, 1984. Can. Data Rep. Fish. Aquat. Sci. No. 645. v + 13 p.

On a mesuré à deux reprises en 1984 les caractéristiques chemiques de huit rivières situées dans le comté de Guysborough (Nouvelle-Écosse). Aucun saumon juvénile n'a été relâché dans ces rivières au cours des dernières années, mais certaines d'entre elles sont considérées comme des sites possibles pour la mise en oeuvre de programmes de mise en valeur du saumon. L'analyse des caractéristiques chemiques présentées dans ce rapport pourra aider à déterminer la sensibilité de ces rivières aux précipitations acides, à faciliter la planification de programmes de mise en valeur du saumon et à choisir des sites propices au relâchement de juvéniles élevés en piscifacture.

INTRODUCTION

A number of mainland Nova Scotia rivers which drain to the Atlantic coast have become more acidic during at least the past 30 years in response to increased acid loading by precipitation (Watt et al. 1983). The most seriously acidified rivers are those found on bedrock composed of granite and/or greywacke, and in some rivers, the native populations of Atlantic salmon have become extinct. Rivers which lie on slate have higher pH values and the highest values are found for rivers which drain areas of carboniferous sediments. Watt et al. (1983) also demonstrated that the pH values of some rivers are inversely correlated with their rates of discharge, so that pH values are maximal during the late summer when discharge is lowest and minimal during the winter when discharge is usually greatest.

Only limited information of the chemical characteristics of rivers located in Guysborough County, Nova Scotia, was previously available. Thus, the chemical characteristics of eight of these rivers were measured in 1984, once during a period of high discharge and once during low discharge. Selection of the two sampling periods was made to gain insight into the ranges of pH which presently occur in the rivers. The major tributaries of the eight rivers were sampled on both occasions to provide information on the chemical characteristics of each river's entire drainage area.

MATERIALS AND METHODS

Several sites on the Guysborough, Salmon, Cole Harbour, Larrys, New Harbour, Isaacs Harbour, Country Harbour, and Indian rivers were visited during May and again during December of 1984 to obtain water samples. Samples were collected at each site in 500-mL polyethylene containers which had first been washed and then rinsed in deionized water. Samples taken for metal analyses were collected in 250-mL polyethylene containers which had first been washed in a 50% HNO_3 solution and then rinsed with deionized water. Each sample for metal analysis was preserved by the addition of 1 mL of 50% HNO_3 solution. All chemical analyses of river water were performed upon return to the laboratory. A Metrohm Herisau pH meter was used to determine the pH values of all sites within 24 hours of sampling. Total hardness, total alkalinity, chloride and sulfate were measured by using techniques outlined in Environment Canada (1981): total hardness, as $CaCO_3$, by EDTA titration to Eriochrome Black T colour change; total alkalinity, as $CaCO_3$, by potentiometric titration with H_2SO_4 to pH end points of 4.5 and 4.2; chloride by the automated thiocyanate method; and sulfate by titration with barium chloride, after adding thorin indicator. Specific conductance was determined at 25°C by use of a Metrohm Herisau conductivity meter and apparent colour was measured with a Helige Aqua Tester. Concentrations of calcium, magnesium and aluminum were determined by emission spectrophotometer (Jarrel-Ash, AtomComp).

Flow rates of the rivers included in the study were measured on December 4 and 5. For each river site, an Ott current metre (Model C-1) was used to measure velocity at three equally spaced positions on a line delineating the width of the river. The propeller of the metre was adjusted at each position so that measurements were made at 0.6 of total depth. Flow rate was then estimated from the equation: $R = W \cdot D \cdot V$ where:

R = flow rate or volume
W = river width
D = river depth (average of 3 measurements)
V = water velocity (average of 3 measurements)

Flow rates of the rivers on the May 30 and 31 sampling dates were estimated from their respective flows on December 4 and 5 and from the ratios of the flows recorded on these dates by the Inland Waters Directorate for the nearby Clam Harbour River (Station 01ER001).

ACKNOWLEDGEMENTS

We are indebted to O. Vaidya who conducted the metal analyses and to W. Horne who provided valuable assistance with the chloride determinations. Trudy Hart typed the manuscript; Ron MacNeil photographed the illustrations and prepared the cover artwork. K.E.H. Smith reviewed the manuscript and provided valuable editorial comments.

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Environment Canada. 1981. Analytical methods manual update. Inland Waters Directorate, Water Quality Branch, Ottawa, Canada. Parts 1 to 7.

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TABLE 1. Some chemical characteristics of the Guysborough River system during May and December, 1984.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al
							(mg/L)				(µg/L)
May 30 (flow[1] - 0.927 m^3/s)											
A1	Above head of tide	6.89	7.2	10.8	35.0	25	2.5	0.8	4.2	3.2	<25
A2	North Intervale Brook	6.55	3.9	6.8	27.6	25					
A3	South Brook	6.80	6.5	9.7	32.7	25					
A4	Atwater Brook	5.40	<0.5	3.4	21.1	110					
December 4 (flow - 2.729 m^3/s)											
A1	Above head of tide	6.73	5.4	12.1	45.5	40	3.5	1.2	6.7	4.3	160
A2	North Intervale Brook	6.30	1.8	9.1	41.6	25					
A3	South Brook	6.71	6.1	12.3	44.0	25					
A4	Atwater Brook	5.10	<0.5	5.8	34.2	45					

1. Estimated.

TABLE 2. Some chemical characteristics of the Salmon River system during May and December, 1984.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al
							(mg/L)				(µg/L)
May 30 (flow[1] - 2.953 m^3/s)											
B1	Above head of tide	6.40	2.2	5.4	25.0	25	1.2	0.5	4.3	3.1	<25
B2	Godfry Brook	6.69	4.9	8.3	35.0	35					
B3	McAllister Brook	6.05	1.8	5.1	24.8	15					
B4	Minister Brook	6.49	2.2	5.5	24.7	55					
B5	Salmon River, below Salmon River Lake	6.09	1.6	5.0	24.0	35					
B6	Porter River	-	-	-	-	-					
December 4 (flow - 8.690 m^3/s)											
B1	Above head of tide	6.35	3.0	9.2	40.7	25	2.6	0.9	6.7	3.5	60
B2	Godfry Brook	6.60	6.3	11.8	43.1	30					
B3	McAllister Brook	6.00	1.1	9.2	40.8	40					
B4	Minister Brook	6.20	2.0	9.0	37.5	30					
B5	Salmon River, below Salmon River Lake	6.14	2.0	7.6	33.3	25					
B6	Port River	6.14	3.1	10.8	46.3	55					

1. Estimated.

TABLE 3. Some chemical characteristics of the Cole Harbour River system during May and December, 1984.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
May 30 (flow[1] - 0.420 m^3/s)											
C1	Above head of tide	4.90	<0.5	3.6	37.4	55	0.5	0.5	7.3	3.0	120
C2	Cole Harbour River, below Hendsbee Lake	4.35	<0.5	2.5	48.4	130					
December 4 (flow - 1.236 m^3/s)											
C1	Above head of tide	4.93	<0.5	4.9	41.8	80	0.8	0.8	7.9	2.9	220
C2	Cole Harbour River, below Hendsbee Lake	4.15	<0.5	2.9	69.2	130					

1. Estimated.

TABLE 4. Some chemical characteristics of Larrys River system during May and December, 1984.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
May 30											
D1	Larrys River, above Trout Lake	4.60	<0.5	2.5	35.4	110	0.3	0.3	6.2	2.3	100
December 4											
D1	Larrys River, above Trout Lake	4.44	<0.5	3.7	51.7	65	0.7	0.7	10.9	3.4	140

TABLE 5. Some chemical characteristics of New Harbour River system during May and December, 1984.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
May 30											
E1	Above head of tide	5.10	<0.5	3.0	26.0	25	0.4	0.4	4.8	2.8	<25
E2	New Harbour River, below Otter Lake	5.06	<0.5	3.5	25.4	55					
E3	Patterson Brook	4.72	<0.5	2.8	29.4	35					
December 5											
E1	Above head of tide	4.90	<0.5	4.4	32.6	40	0.7	0.6	6.0	3.1	150
E2	New Harbour River, below Otter Lake	4.72	<0.5	5.0	35.8	65					
E3	Patterson Brook	4.68	<0.5	3.3	34.1	40					

TABLE 6. Some chemical characteristics of Isaacs Harbour River system during May and December, 1984.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
May 31 (flow[1] - 0.841 m^3/s)											
F1	Above head of tide	4.89	<0.5	2.5	23.7	55	0.4	0.3	4.0	2.3	140
F2	Isaacs Harbour River below Beech Lake	4.80	<0.5	2.5	26.1	110					
December 5 (flow - 2.750 m^3/s)											
F1	Above head of tide	4.83	<0.5	3.9	30.6	55	0.7	0.5	5.6	3.3	140
F2	Isaacs Harbour River, below Beech Lake	4.42	<0.5	3.4	37.6	100					

1. Estimated.

TABLE 7. Some chemical characteristics of Country Harbour River system during May and December, 1984.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
May 31 (flow[1] - 1.764 m^3/s)											
G1	Above head of tide	6.20	1.9	4.5	26.3	25	0.8	0.5	4.8	2.6	40
G2	Gum Brook	5.82	0.6	2.9	20.4	25					
G3	Sinclair Brook	6.05	0.9	3.6	21.6	25					
G4	Outflow from Pringle Lake	6.40	3.5	8.3	40.0	15					
G5	Outflow from Goshen Lake	6.59	10.9	14.4	49.4	45					
December 5 (flow - 5.766 m^3/s)											
G1	Above head of tide	5.68	1.0	6.1	34.7	40	1.3	0.9	6.2	2.9	90
G2	Gum Brook	5.48	0.5	5.3	30.9	30					
G3	Sinclair Brook	5.45	<0.5	6.9	34.1	55					
G4	Outflow from Pringle Lake	6.48	3.9	8.5	44.9	15					
G5	Outflow from Goshen Lake	6.75	12.2	18.6	69.9	35					

1. Estimated.

TABLE 8. Some chemical characteristics of Indian River system during May and December, 1984.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
May 31 (flow[1] - 0.857 m^3/s)											
H1	Above head of tide	4.65	<0.5	2.0	26.1	110	-	-	-	-	-
December 5 (flow - 2.803 m^3/s)											
H1	Above head of tide	4.61	<0.5	4.2	35.3	50	0.7	0.6	6.6	3.5	220

1. Estimated.

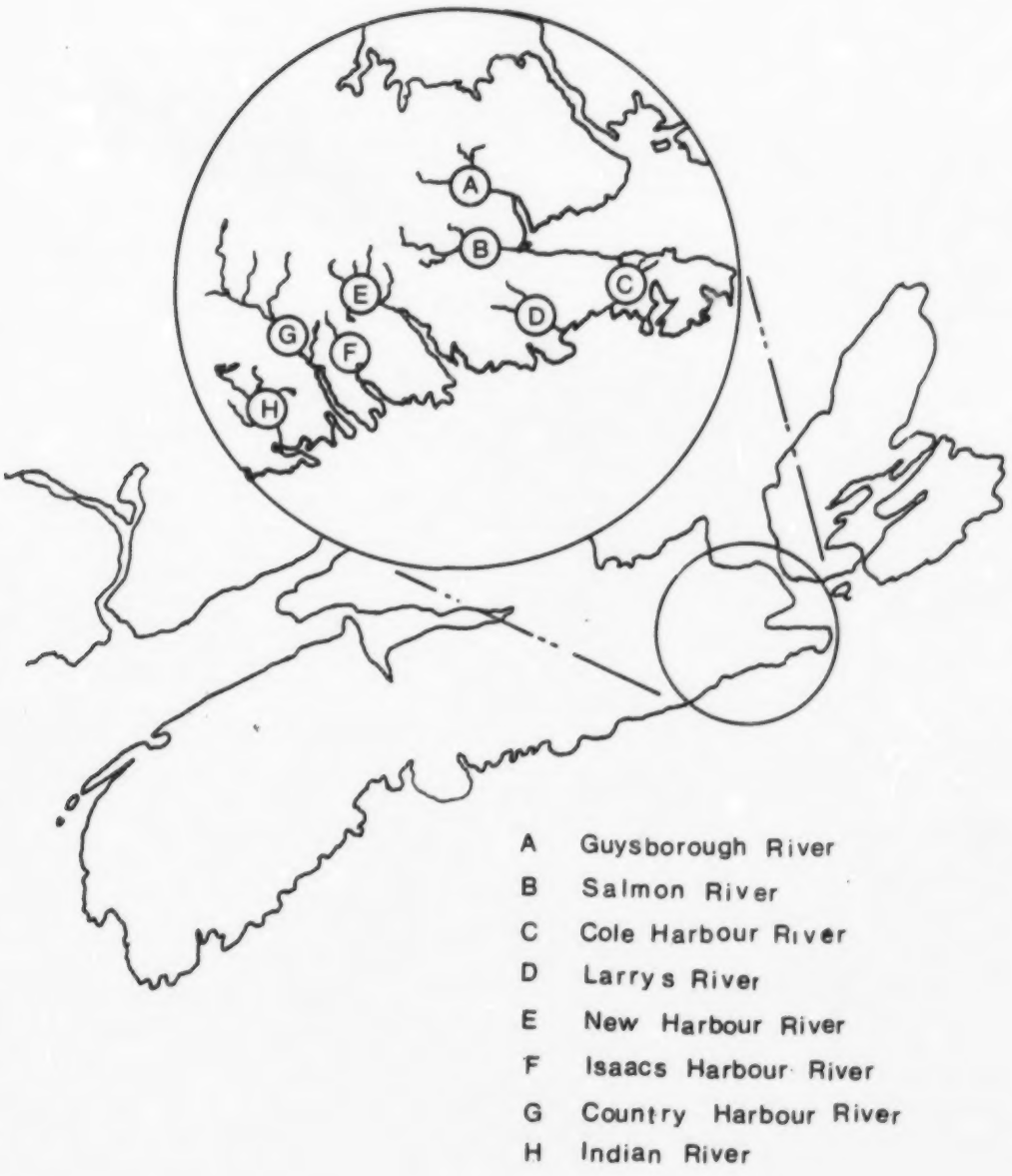

FIG. 1. Location of rivers included in the sampling program.

FIG. 2. Water sampling sites on Guysborough River.

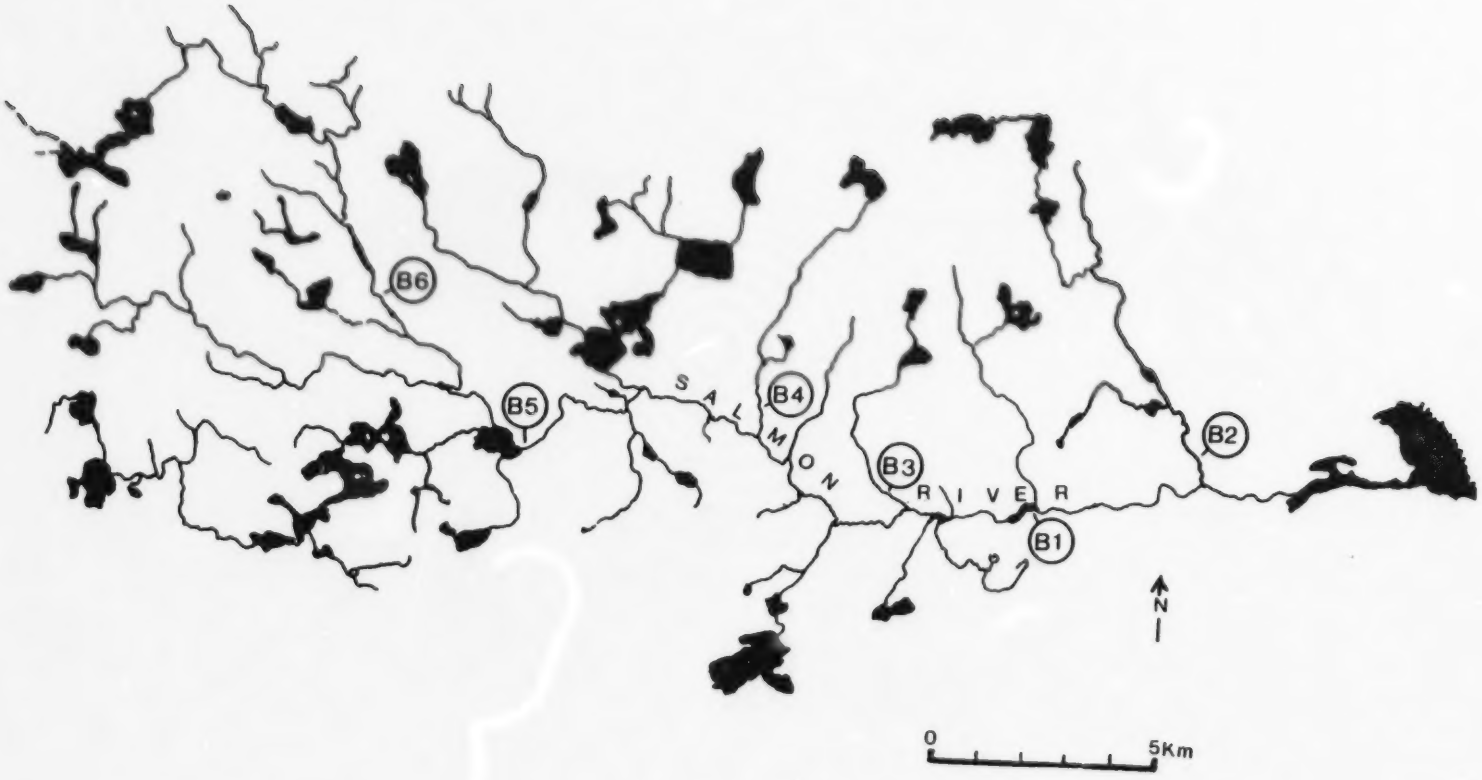

FIG. 3. Water sampling sites on Salmon River.

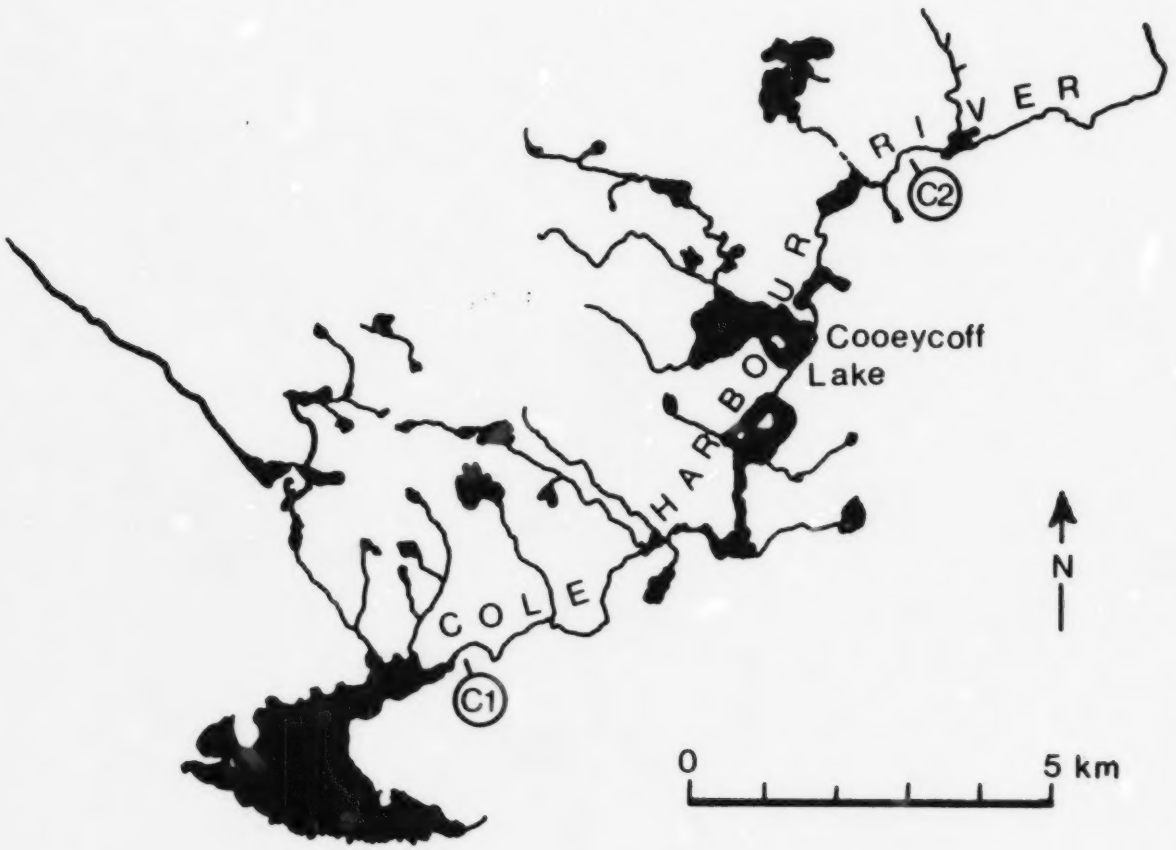

FIG. 4. Water sampling sites on Cole Harbour River.

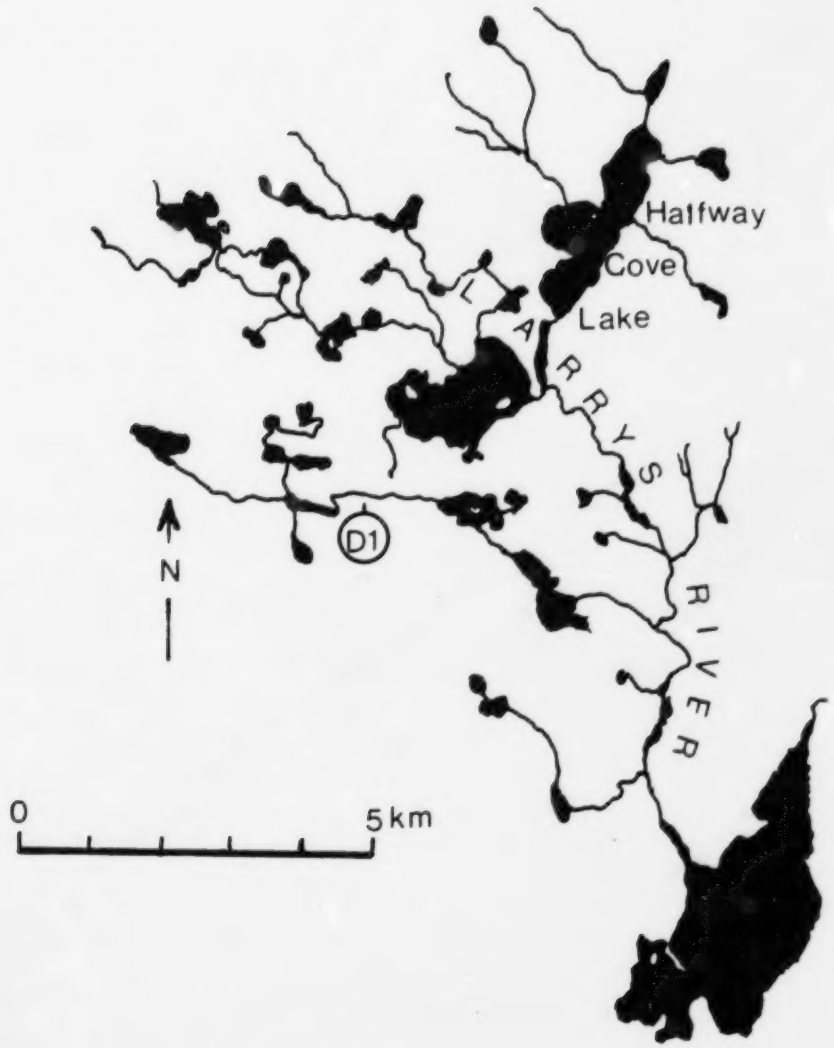

FIG. 5. Water sampling site on Larrys River.

FIG. 6. Water sampling sites on New Harbour River.

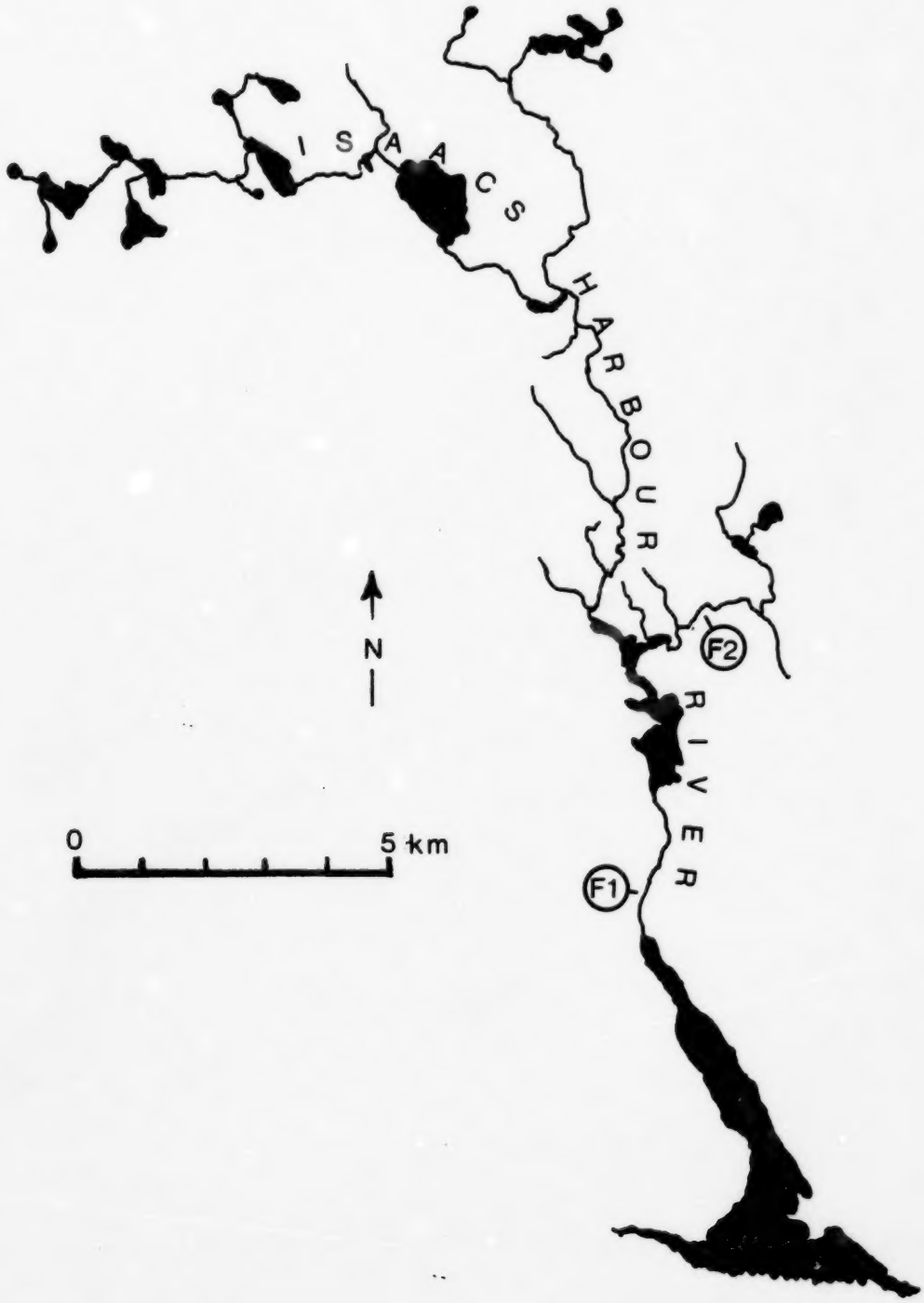

FIG. 7. Water sampling sites on Isaacs Harbour River.

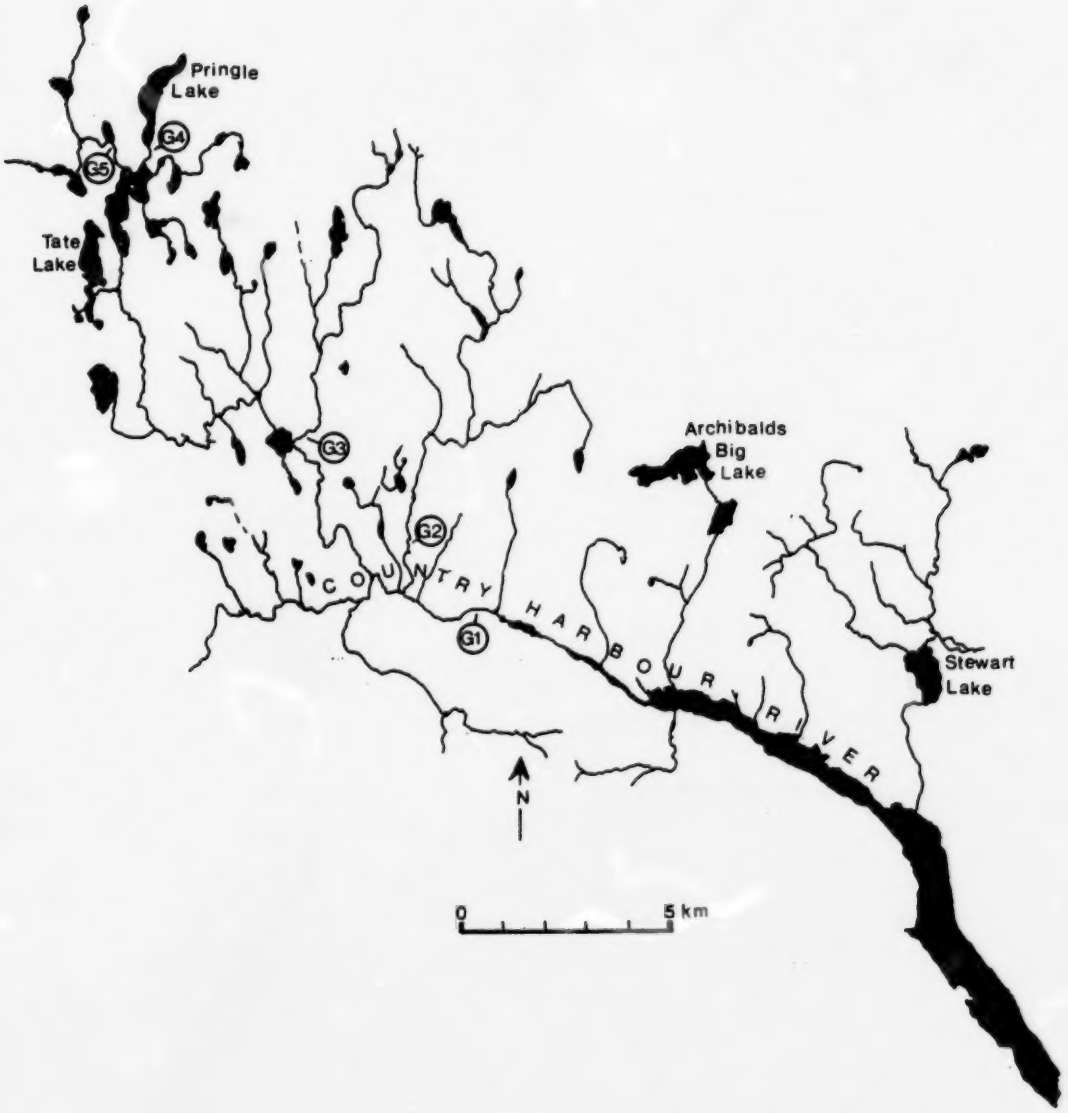

FIG. 8. Water sampling sites on Country Harbour River.

FIG. 9. Water sampling sites on Indian River.